

1 of systems. It is easy to get into technology and
2 well beyond when it was right.

3 I think when we look at spectrum, we
4 are all sitting here, and we just finished the
5 blood bath on 3G. If you have been involved in
6 that process, people are still reconciling earlier
7 Congressional actions.

8 All of those presume a framework that
9 we see as evolving and new, but there is no reason
10 to believe that is the framework of the future.
11 Maybe in fact we should run away from it very
12 rapidly.

13 And I have heard some of the other
14 panelists, and I have talked and heard a lot about
15 cell phones, and 4G cell phones, and 3G cell
16 phones. But I have not heard people talking about
17 how those same rule frameworks work if the
18 frameworks are ad hoc, peer-to-peer networking.

19 What if 802.11 is the answer and not a
20 cell phone. What if it is infrastructure less
21 rather than infrastructure based. Certainly from
22 the Department of Defense, we are looking at
23 technology that is infrastructureless, because
24 there is no infrastructure where we want to go.

25 And so we are going to be pumping

1 literally billions of dollars over the next tens of
2 years into infrastructureless technologies. So it
3 is not enough to merely prove that we have the
4 right spectrum base to allow us to go to 3G cell
5 phone and 4G cell phone, and even 5G.

6 We ought to be thinking about what if
7 it is done completely differently. Being friendly
8 to one mode may be really doing technology
9 selection for the other.

10 So I have done my moderator's
11 preoperative. I would like to go around the panel
12 and introduce them if I can find my right sheet
13 here. We have already introduced myself as the
14 moderator.

15 Ron Haraseth, Director of APCO,
16 Automated Frequency Coordination. I thought they
17 would be in order.

18 MR. ENGELMAN: There are not in order.

19 MR. MARSHALL: Thanks for telling me.
20 Brent Wilkins -- raise your hand please -- managing
21 director of Cantor Fitzgerald. Gerald -- help me
22 out please.

23 PROF. FAULHABER: Faulhaber.

24 MR. MARSHALL: Gerald Faulhaber,
25 Professor of Business and Public Policy at Wharton.

1 Marc Goldberg, from ArrayComm; Michael Fitch,
2 Director of Spectrum Management, at Boeing; and
3 Michael Lynch, Senior Manager of Spectrum
4 Regulation, from Nortel.

5 We had a number of questions, and what
6 I would like to do is start us out and the question
7 I was given by my FCC co-moderator, and I think it
8 is a good one, is what current or new technologies
9 under development may influence the effective use
10 of spectrum; what may decrease or impede the
11 effective use of spectrum.

12 And then what is the rule implications
13 of those, and I think we will just start and go
14 down the panel.

15 DR. GOLDBURG: Thanks, Preston. Let me
16 mention two technologies briefly. One of them is
17 software defined radios, and we have heard a little
18 bit about that earlier in the session today, and
19 the other one is adaptive antennas.

20 We heard the words or the phrase offer
21 to define radios and offered up as sort of a
22 panacea to a whole wealth of spectrum issues, and I
23 think the class of radio technologies, where the
24 radio is software configurable, to be able to
25 handle different modulation formats, or potentially

1 work in different bands, is valuable.

2 I think the thing that gets left out of
3 the current discussion is many of those
4 capabilities are in today's current radios. If you
5 look at CDMA systems, which changed our spreading
6 factor to handle interference, or GSM, which
7 changes its coding rates; or 802.11, which changes
8 its spreading factor.

9 Most modern communications systems, at
10 least the cellular ones that I mentioned, have
11 elements of software defined radios in it. So I
12 think that as an industry that we are already
13 taking pretty good advantage of that technology to
14 handle interference and provide services under a
15 variety of link conditions.

16 And it is not clear to me that there is
17 this huge incremental piece of low-hanging fruit
18 that we have not taken advantage of already. That
19 is one comment.

20 The other one, which is a little bit of
21 a pitch given where I am from, but it is also
22 something that I very much believe in, is the
23 concept of adaptive antenna systems. Spectral
24 efficiency is about -- at least for heavily used
25 systems, is about managing interference.

1 And adaptive antennas are a technology
2 that are able to do a better job of focusing energy
3 on users, rather than sort of spraying energy
4 throughout the whole cell. And as a result of
5 that, they can have a very dramatic effect on
6 spectral efficiency that has been shown in a
7 variety of commercial deployments.

8 MR. MARSHALL: Do you want to connect
9 that to rules and regulations? That was the panel
10 that you were put on. You are one of the two
11 panels here, and you are talking to lawyers here.

12 DR. GOLDBURG: Rules and regulations.
13 Sorry. My bad (sic). I think the connection is
14 this. There are a variety of technologies out
15 there which have individually or in combination
16 been used to increase spectral efficiency of
17 systems over time.

18 And I think what the Commission should
19 be doing is attempting to look overall throughout
20 the industry and looking at best practices, and
21 potentially coming up with some target performance
22 levels, but not necessarily mandating technology.
23 That is best left to the technology developers, and
24 the people who have to deploy and operate the
25 systems.

1 MR. LYNCH: Well, actually he stole
2 some of the points that I would have liked to have
3 brought up, but that's okay.

4 MR. MARSHALL: You get two of your own.

5 MR. LYNCH: I think one of the things
6 that has got a lot of the manufacturers and
7 operators sort of stirred up today is ultra
8 wideband, and we look at it as a glass half-full,
9 and a glass half-empty.

10 We don't manufacture it, but we see it
11 as a great potential, but we also say it as a great
12 potential for harm if the rules again aren't
13 correct.

14 And one of the other little hooks that we would
15 like to throw into that one is the term, spectral
16 efficiency.

17 If you look strictly at it, it looks
18 very, very efficient, but is it really? Spectral
19 efficiency from a rule point of view isn't I think
20 the way to go, and the way I would preface my
21 remarks is to say to a degree, but an efficient use
22 of the spectrum is maybe a better standard to use.

23 And just because I get 44 megabits down
24 the pipe doesn't mean that I am using it -- that a
25 technology that doesn't do that is using it

1 inefficiency. So I think there has to be a balance
2 in there somewhere.

3 And again the rules, yes, the rules
4 have to help everybody, and again, UWB, we are
5 going to be talking about that for a couple of more
6 years I imagine, and what kind of rules should or
7 should not be in place on that.

8 But also how do we define a technology
9 that is efficiently using the spectrum, rather than
10 putting out a rule that says you have to push this
11 much down the pipe in order to have your technology
12 accepted.

13 I think that those are not mutually
14 exclusive, but we prefer the efficient use of
15 spectrum in our model rather than saying how much
16 has to go down the pipe, or how much per kilobyte
17 or per kilohertz, whatever the standard is.

18 MR. MARSHALL: Okay. Thanks.

19 MR. HARASETH: From a public safety
20 perspective, I think one of the things that I just
21 wanted to bring up is especially in light of some
22 of the newer technologies in the ultra-wide band,
23 the software-defined radios is security.

24 Public safety is not one that accepts
25 change really quickly, and it is also one that

1 doesn't necessarily -- security is a relatively new
2 issue, but we are taking a lot of our lead from the
3 Federal government issues, and that security is
4 obviously a really big item there.

5 The other thing is that we are talking
6 about efficiency, and the use of these new
7 technologies, and these new technologies are
8 letting us do all kinds of new things. And it just
9 struck me sitting up here listening to this that
10 this is like at home.

11 You have got an empty closet or an
12 empty garage, and how long is it going to stay that
13 way. So it is not a case of efficiency of
14 technology that you are using.

15 It is an efficiency of how you are
16 using that technology, and what you are allowing to
17 run down that pipeline. Is it junk sitting in the
18 garage and it won't let you park the car, or is it
19 something worthwhile.

20 MR. WILKINS: I want to ask the
21 question a little bit differently, and on the fact
22 that on the technological standpoint, I am not
23 going to talk about the technology of the spectrum,
24 but merely the technology of the trading mechanism.

25 Cantor Fitzgerald is looking at this

1 market from a standpoint of how can this best be an
2 efficient market, and our company has been involved
3 in trading products for years, from an electronics
4 standpoint, as well as a human brokerage
5 standpoint.

6 And the technology does exist today to
7 trade it. The question becomes if it is 10 trades,
8 or 50 trades, a thousand trades between the
9 counter-parties, does the technology exist today to
10 actually trade spectrum in a variety of forms.

11 PROF. FAULHABER: I am actually going
12 to defer my time until we get to policy
13 considerations, because we are largely rearranging
14 deck chairs on the Titanic here when talk about
15 little tweaks, and I would like for us to go for
16 the lifeboats. So if I could hold my time for the
17 next --

18 MR. LYNCH: That is a hard
19 characterization to follow.

20 PROF. FAULHABER: Sorry, Mike.

21 MR. FITCH: No, that's all right.
22 Well, I will speak a little bit to technology in
23 the satellite context, and there what we have is a
24 number of trends, but I would agree with Marc's
25 comments that it is not that there are low-hanging

1 fruit and some gigantic leap forward overnight in
2 any regard.

3 But the trends that I think relate to
4 efficient use of spectrum, more power on the
5 satellites generally capable of, and reconfigurable
6 antennas, spot beams, on board processing, on board
7 beam-forming with antennas.

8 The result of these technology advances
9 is a combination of more throughput overall, and
10 more directed throughput to where the requirements
11 actually are, and in some cases smaller and cheaper
12 earth station terminals, therefore reducing the
13 cost to the consumers.

14 Regulatorily, these are all pretty
15 compatible with the Commission's rules. The
16 Commission's rules in the satellite services have
17 generally allowed a pretty high degree of
18 flexibility to the operators working amongst
19 themselves, and that has enabled transitions,
20 albeit gradual, as technology advances.

21 MR. ENGELMAN: Does anyone from the
22 audience want to jump in with some ideas or
23 thoughts? Again, the question was what current or
24 new technologies under development may increase
25 efficient use of the spectrum or may hinder it?

1 There is no one out there with a good,
2 new idea? In the front row. If you would wait for
3 a microphone, please.

4 MR. MARSHALL: Thank you. My name is
5 Jim Marshall, and I work with the Mitre
6 Corporation. One of the things that has been
7 brought up from time to time is the potential
8 advantage of spectrum aggregation.

9 And I was wondering if the panel might
10 comment on that and its advantages and
11 disadvantages.

12 MR. ENGELMAN: Okay. Anyone have any
13 thoughts? I would ask maybe Cantor -- for Brent to
14 talk about spectrum aggregation, because this is
15 the ability, I think to put bits and pieces of
16 spectrum together into a useable plan.

17 MR. WILKINS: Well, the issue becomes
18 on any type of traded commodity for a better word,
19 is to somehow have a standardized agreement from
20 which to train or transact. I think the issue
21 becomes how do you put together that type of an
22 agreement between spectrum allocation.

23 You have to have some kind of
24 standardized format, or some kind of rules and
25 regulations that all the counterparties can agree

1 to. I think what happened in our experience has
2 been that we looked at the wireline industry quite
3 heavily, and there are some issues there because a
4 lot of counterparties could not agree to what those
5 rules and conditions, terms and conditions, could
6 be in the contract.

7 There are some issues I think from a
8 standpoint of defining the spectrum, defining that
9 the rules and the terms that the counterparties can
10 address, and I think by doing that that you can
11 actually have something that can be traded and
12 transacted between the parties in such a manner.

13 MR. ENGELMAN: Gerry.

14 PROF. FAULHABER: This is a good issue,
15 particularly as I am going to be talking about in a
16 minute or two when you begin to consider property
17 rights in markets models associated with spectrum.

18 If we think of private goods, and let's
19 say land, for example, it turns out that it is much
20 easier to subdivide it than it is to aggregate it
21 through property markets

22 And which is why it is sometimes
23 difficult to put together enough property for a
24 shopping mall. It is a lot easier to subdivide it
25 than it is to aggregate it again.

1 And once we move towards a property
2 rights model, which I am sure that my colleague
3 here would be very excited about, that we have to
4 somehow address that problem of ease of
5 aggregation, because it could be a problem within
6 the context of property rights and markets.

7 MR. ENGELMAN: Does anybody else want
8 to --

9 MR. MARSHALL: I would just like to
10 state that I think that as an alternative view that
11 says that I don't need to aggregate spectrum
12 physically. That when we take and leverage the
13 increasing SDR capabilities, and non-contiguous
14 modulations, that another approach is to become
15 better at accepting the reality of a very
16 anarchistic environment of spectrum, and look to
17 modulations that are non-contiguous and no-
18 symmetric energy.

19 And to exploit holes rather than trying
20 to statically collapse them, and put the
21 subdivision back together again. I think you have
22 got two different paths there. One is a regulatory
23 and the other is to develop technology that accepts
24 we are what we are, and some things are just very
25 hard to put the genie back in the bottle.

1 MR. ENGELMAN: Okay. I think I saw
2 another question or two in the audience. Over
3 here. Can we have a microphone, please.

4 MR. GILLIG: Steve Gillig, Motorola.
5 This was something that didn't come out this
6 morning too much, but certainly people are talking
7 about Joe Mattola, about cognitive radio, which is
8 a radio that somehow senses its environment, and
9 senses interference, has the ability to look for
10 open spectrum either by itself or through the
11 system.

12 And so it sounds like an exciting
13 technology. It certainly is a little ways off
14 before we would be able to implement that, but
15 before we could even implement something like that,
16 there would have to be certain policies enacted
17 that would allow spectrum, be it contiguous or lots
18 of little blocks, to be able to be marketed and be
19 able to be sold.

20 Otherwise, all this capability isn't
21 going to do you any good if you can't jump to
22 unused spectrum and figure out how you are going to
23 pay for that, and how people are going to offer
24 that for service.

25 So that is something that has to come

1 with the policy first before the technology could
2 make use of it.

3 MR. MARSHALL: I can't comment on that,
4 because that is my position description at DARPA,
5 is building such a radio. So I am the wrong guy to
6 say anything.

7 MR. WILKINS: I have just got one
8 comment. On the wireline side, one of the reasons,
9 and one of the problems they had on the wireline
10 trading industry was the fact of the
11 interconnectivity.

12 But if also we are just talking about
13 rights -- you know, trading rights to the spectrum,
14 you don't have interconnectivity problems with the
15 delivery issues that happened with the wireline
16 side.

17 That is a point to consider when you
18 are looking at the rights of the spectrum; trading
19 as rights, versus actually looking at the physical
20 delivery of the spectrum itself.

21 MR. MARSHALL: Would you like to talk
22 about that from a policy perspective, because he
23 was basically addressing that tension between
24 policy.

25 PROF. FAULHABER: Do we have a minute

1 or two so I can --

2 MR. MARSHALL: You deferred the time.
3 So this is your little bucket here of your time.

4 PROF. FAULHABER: I sort of made this
5 provocative comment about rearranging the deck
6 chairs. And let me actually say what that means
7 and how it fits in, I think, to your question,
8 which is -- well, let me make it clear what the
9 current system is, okay?

10 We all sort of think that we know what
11 it is, but it is basically administration of an
12 important national resource by administrative fiat.

13 Okay. We make rules about things, and that is
14 what we do here at the FCC, or I used to be here.

15 I tried not to make rules, but that's
16 what we do here, okay? And we have done that for
17 75 years. We sort of decide where things are going
18 to go, and we hand it out to people.

19 And we have changed that a little bit
20 in the last 10 years, okay, because we now have a
21 little bit of auctions, but there is less there
22 than meets the eye.

23 Now the fact is that you might say that
24 here we are in the center of democratic capitalism,
25 and how are we passing, or how are we allocating

1 this scarce national resource? Well, we are doing
2 it by administrative fiat.

3 You know, if it were really important,
4 like food, clothing, or shelter, we would let the
5 market do it wouldn't we? Okay. Well, you know,
6 somehow we don't do that.

7 Well, is there any precedent for this,
8 and of course there is. There used to be this
9 country
10 -- and some of us might remember -- the Soviet
11 Union, and they had an agency called Gosplan, and
12 that's what Gosplan did. It used to pass out
13 everything.

14 And what the FCC does is that we are
15 sort of the Gosplan of spectrum, okay? We sort of
16 pass it out and if you are good, we will let you
17 have more. And we know that model doesn't work.

18 Ronald Couse, the Nobel Laureate, said
19 so in 1959, and he was considered a crank for
20 pointing out that Gosplan is probably not a good
21 thing as a way to allocate resources.

22 And ever since then, economists have
23 argued, look, this is insane. What you should do
24 is get this out into the market, and get the
25 government out of the business as Preston has said,

1 but in a different way.

2 It's like establish property rights,
3 and auction the dam stuff off and get out of the
4 business, and let secondary markets, such as Cantor
5 Fitzgerald, solve this problem for you. That's how
6 we deal with real estate, and you know, it seems to
7 work, okay?

8 And economists are sort of beating the
9 drum on this for 40 years. We will hear some more
10 of that at the next session, and it is hard to
11 argue that the markets don't do a fairly reasonable
12 job at things as long as we don't interfere with
13 them too much.

14 And, of course, as an economist, I
15 would have to say that. However, what Preston
16 indicated also is another strain to reform, and
17 just saying, okay, you know, the answer is not
18 necessarily to go to markets, but what we should be
19 doing is deploying these new technologies.

20 Okay. The brave new world of mesh
21 networks, agile radio, ultra-wide band, generally
22 wide-band technologies, which guess what, they
23 don't take many spectrum at all.

24 They kind of sneak in kind of various
25 places, and they really are very efficient, and use

1 it tremendously. In which case, the whole thing of
2 spectrum scarcity will go away, because all this
3 stuff about managing it, even property rights, is
4 about scarcity.

5 And what we hear Preston saying is that
6 in this brave new world there ain't going to be any
7 scarcity, okay? So to some extent the technology
8 guys are saying, yes, we think the present system
9 sucks. You know, Gosplan is not the way to go, and
10 we should go to commons.

11 The commons are saying, yes, Gosplan
12 sucks, and let's go to markets. And in fact what
13 we have been doing -- and I say we, because my co-
14 author, David Ferber, and I have been working on a
15 plan which attempts to accomplish the best of both;
16 to realize the efficiency of the markets through a
17 property rights scheme, and yet has sufficient
18 accommodation for ultra-wide band agile radio
19 through what we call a non-interference easement
20 that we could use markets.

21 But we could also get the benefits of
22 commons. So if we want to look beyond Gosplan and
23 say where do we want to be, it strikes me that we
24 may be in a future in which the commons rules.
25 That would be wonderful. No scarcity.

1 I was promised that in 1995 about the
2 internet and it wasn't true, and I hope that it is
3 true this time; or we may be in a world where we
4 are allocating things by markets, and we know that
5 they tend to work a lot better than Gosplan does.

6 So whatever we do is an in-state,
7 wherever we are looking forward to, okay, we need
8 to come with a future scenario that can accommodate
9 either one. And that is sort of what we are trying
10 to propose, at least in our submission, to the
11 Commission; something which is consistent with
12 property rights, as well as with a commons
13 approach, and that is what I would recommend, and
14 get the FCC out of this business, okay?

15 MR. MARSHALL: I would hate to be
16 quoted as necessarily believing in markets quite
17 that strongly.

18 PROF. FAULHABER: Wait a minute. DoD
19 in favor of anarchy? That is a quote.

20 MR. MARSHALL: We are organized. No
21 one else is allowed to.

22 PROF. FAULHABER: Organized anarchy.
23 Okay. I love it.

24 MR. MARSHALL: And I think it would be
25 fair to let the panel comment on your comments,

1 because they go to the heart of some of the other
2 issues. But I think you also ought to put out that
3 markets -- in a lot of places, we don't allow
4 nuclear power plants to be regulated by market.

5 If I melt down, I will go out of
6 business and go bankrupt. We in fact enforce
7 standards that are not market driven, and the
8 internet was developed with no market behind it.
9 It created incredible wealth, but no one else
10 probably other than DoD would have been willing in
11 the early '70s to invest in it.

12 So I will put in a pitch to at least
13 moderate that drive, and recognize that public
14 safety, public interest, as such. and clearly as
15 the Department of Defense, we represent other kinds
16 of interest.

17 No one has ever modeled them in terms
18 of strictly bidding.

19 PROF. FAULHABER: You will respond to
20 the moderator's comments or something like that.

21 MR. MARSHALL: Everyone will respond to
22 yours and mine. And with that -- there are hands
23 up all over the place. So we have got some stuff
24 going.

25 DR. GOLDBURG: Actually, I have a

1 question for Gerald, and I am not an economist, and
2 so you will have to bear with me. But it seems to
3 me that one thing that markets don't focus on is
4 the long term.

5 I mean, they tend to be short-term,
6 mid-term, focused, and if you try to apply that in
7 the context of spectrum -- let's take the example
8 of the television industry today, which is in some
9 sense an industry that is in a certain amount of
10 pain.

11 We could point to their spectrum and
12 say it is used inefficiently, but the reason that
13 it is used inefficiently in some sense is that
14 television, because of its success, developed a
15 huge amount of content that now other techniques --
16 cable, and satellite, and so forth -- are
17 delivering.

18 So in a sense, they are a victim of
19 their own success, and in a pure market-based
20 approach, they may not have had the opportunity to
21 be successful in the first place.

22 PROF. FAULHABER: Well, television sets
23 a sweet example. A couple of acts here. I think
24 the number is around 85 or 86 percent of U.S.
25 households now get television through a pay

1 subscription model. Their main source of
2 television is not over-the-air broadcasts.

3 And that number is growing, okay? To
4 the extent that the television industry identifies
5 itself with over-the-air broadcasts is doomed, and
6 I don't think the television industry does.

7 The television industry is a content
8 business. I actually challenged Michael Eisner on
9 this once, and he readily admitted that he didn't
10 give a damn how television got into people's
11 houses; whether it was over-the-air broadcasts, or
12 cable, or satellite, and he's right.

13 Now, the cleanest -- this is like a fun
14 example, okay? You guys remember UHF television?
15 Channels -- what, 52 to 60? It was this huge swath
16 of the spectrum, which we thought was a great idea
17 back in the 1950s, and we actually for a while
18 mandated that tuners have UHF tuners on them.

19 I doubt -- you would have to look in a
20 junk shop to find a television with a UHF tuner on
21 it anymore, but you know, there are people that are
22 broadcasting in UHF. Nobody is listening, but they
23 are broadcasting.

24 Why is this you might say? Well,
25 because the FCC has this thing called a must-carry

1 rule, which says that anybody that is actually
2 broadcasting in a local area has to be carried by
3 cable.

4 So if you are not broadcasting, you
5 don't get carried by cable. This is an FCC rule.
6 This is what rules do, okay? So now what we have
7 is people actually using the UHF channel. Nobody
8 is listening to it, except on cable.

9 Now, if we were to sort of free this up
10 and say, okay, you know, UPN, WB, and your
11 affiliates, we will grandfather the must-carry
12 clause. Would you like to, let's say for example,
13 sell your spectrum?

14 It would be gone in a heartbeat. Okay.

15 And there is more spectrum out there than we would
16 need for wireless for the next 10 years. Boom.
17 Just like that.

18 Talk about efficiency. That would be a
19 great one, okay? I won't even talk about the
20 digital set-aside. I mean, that is just --

21 MR. MARSHALL: Anyone else?

22 MR. FITCH: I will make a comment.

23 MR. MARSHALL: Okay.

24 MR. FITCH: From the perspective of the
25 Boeing Company, these great theories aren't frankly

1 very useful or appealing. I think they probably --
2 they may or may not apply and be appealing in the
3 broad context of commercial services, commercial
4 wireless versus broadcasting, versus some of the
5 other major categories.

6 Our uses are driven by other
7 considerations. First and foremost, we build
8 airplanes. We use a lot of spectrum. We don't use
9 a lot of spectrum, but we have a lot of spectrum
10 uses that support that enterprise.

11 Obviously the safety implications of
12 those uses are extremely high. On the other hand,
13 that does not make a giant market, and it seems to
14 us that the kind of giant market approach to
15 spectrum would be counter-productive, would be
16 destructive, to these kind of specialized uses that
17 actually are on the whole adequately taken care of
18 under the existing system.

19 Obviously, it could be better, and
20 everybody would like more, and we are all
21 constrained in some way or another. But as we run
22 through a wide range of spectrum interests that we
23 have as an industrial company, none of this fits
24 our needs very well.

25 It is not clear that any of this would